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Yeh

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(54) **LAYERED COMPOSITE MATERIAL**

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filed on Mar. 13, 2003, which is a continuation-in-part
of application No. 10/040,404, filed on Jan. 9, 2002,
now abandoned.

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B63B 1/00 (2006.01)

(52) **U.S. Cl.** 441/65; 441/74

(58) **Field of Classification Search** 441/65,
441/74

See application file for complete search history.

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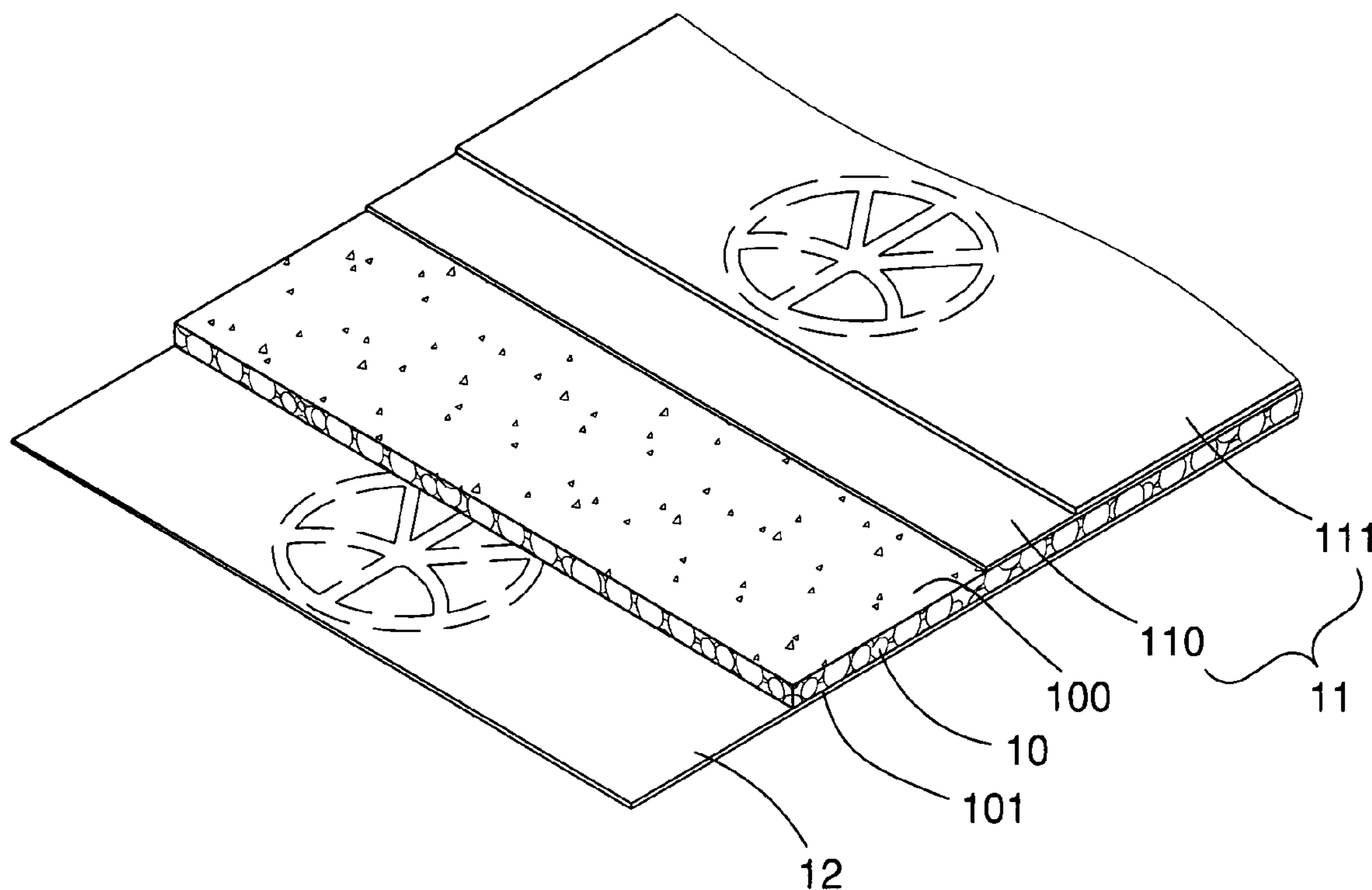
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(57) **ABSTRACT**

This invention relates to a layered composite material,
which comprises a foam skin, a plastic plate and a plastic
film. The foam skin has a density in a range of 1.5 to 12 PCF
and a thickness in a range of 1 to 6 mm. The plastic plate is
laminated to a top surface of the foam skin without adhe-
sives and the plastic plate has a thickness in a range of 0.1
to 2 mm. The plastic film has a surface laminated to a bottom
surface of the foam skin without adhesives and the plastic
film has a thickness in a range of 0.01 to 0.15 mm. In
addition, layered composite material further comprises a
fabric layer laminated to other surface of said plastic film
without adhesives.

1 Claim, 5 Drawing Sheets



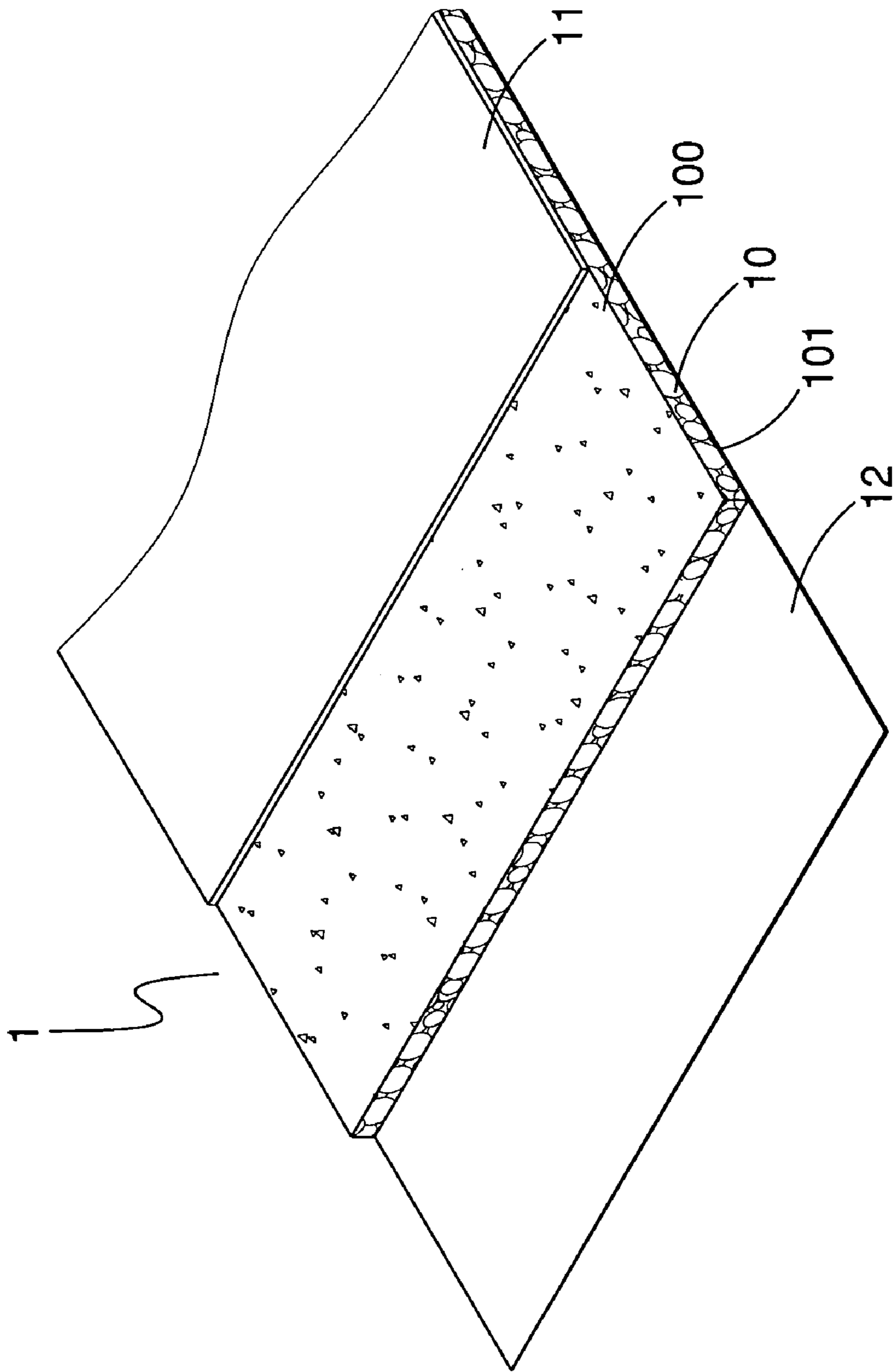


FIG. 1

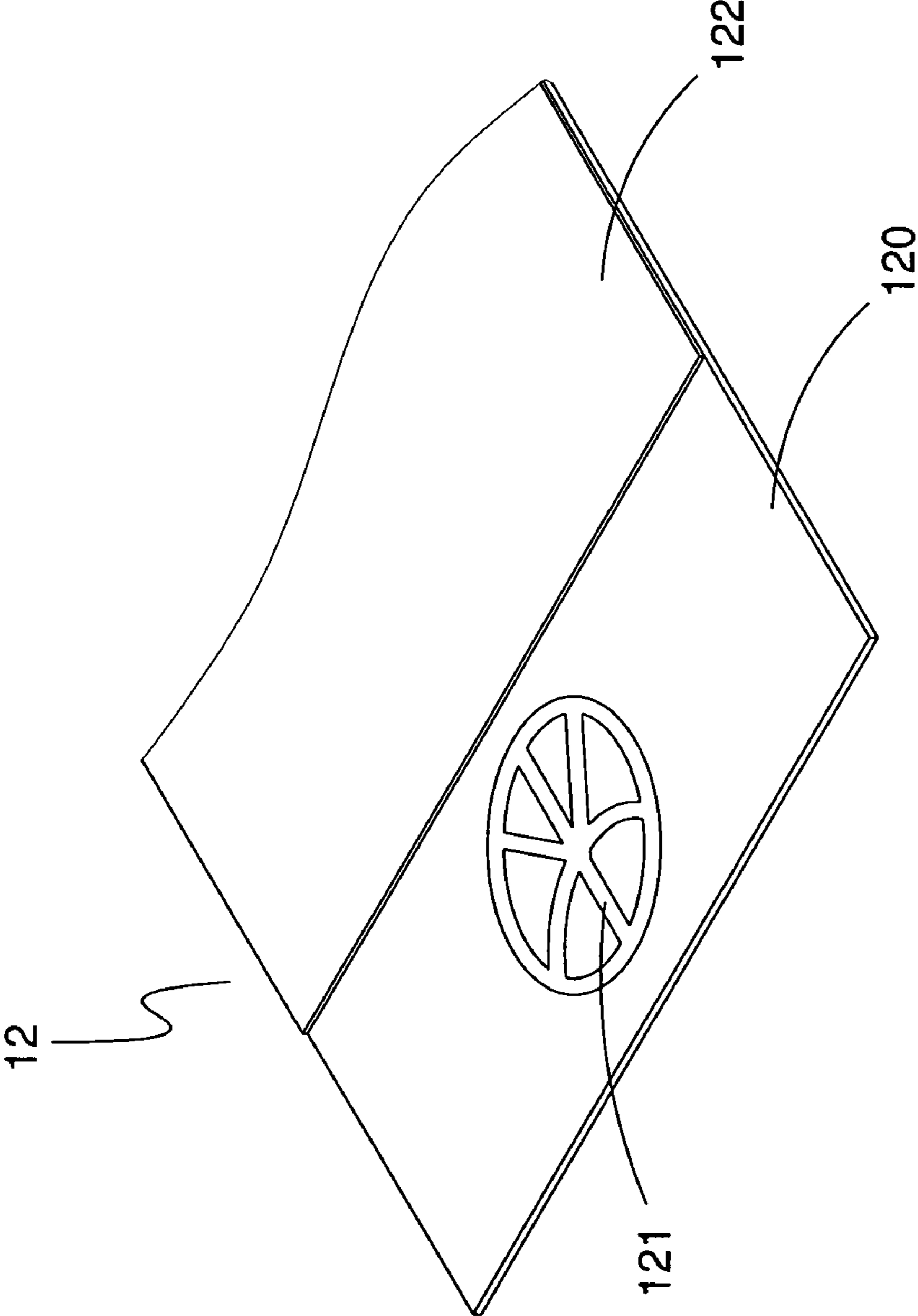


FIG. 2

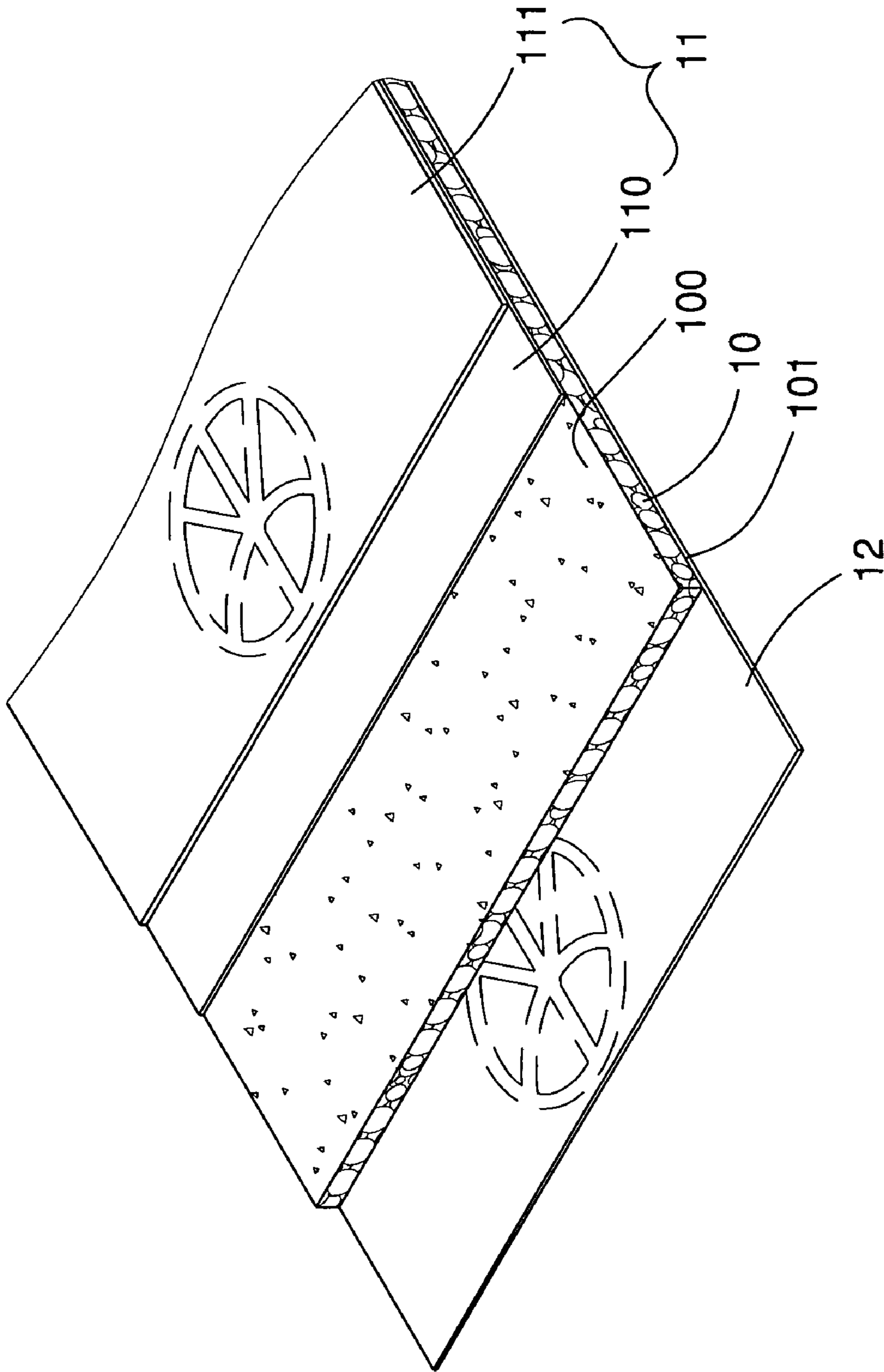


FIG. 3

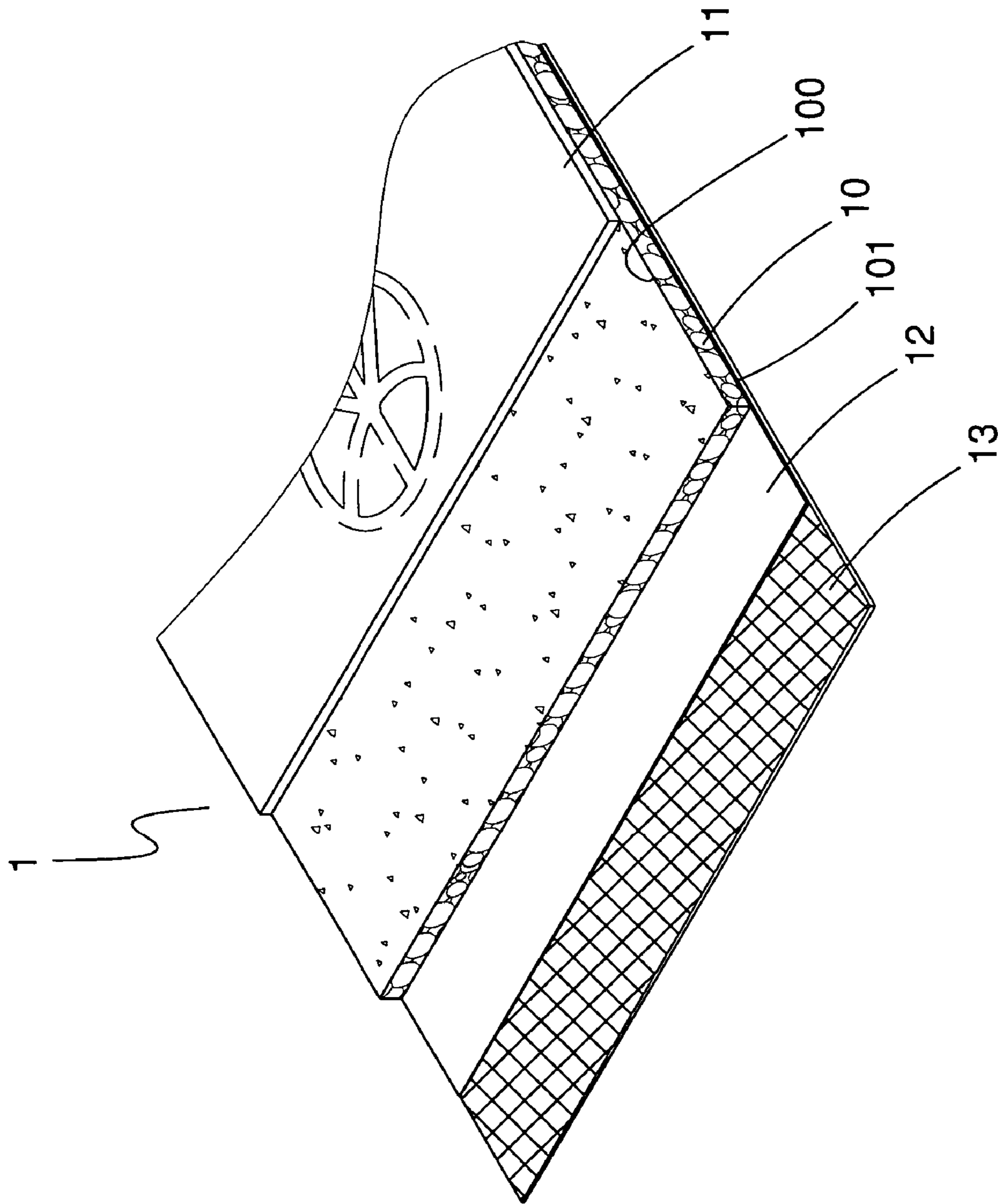


FIG. 4

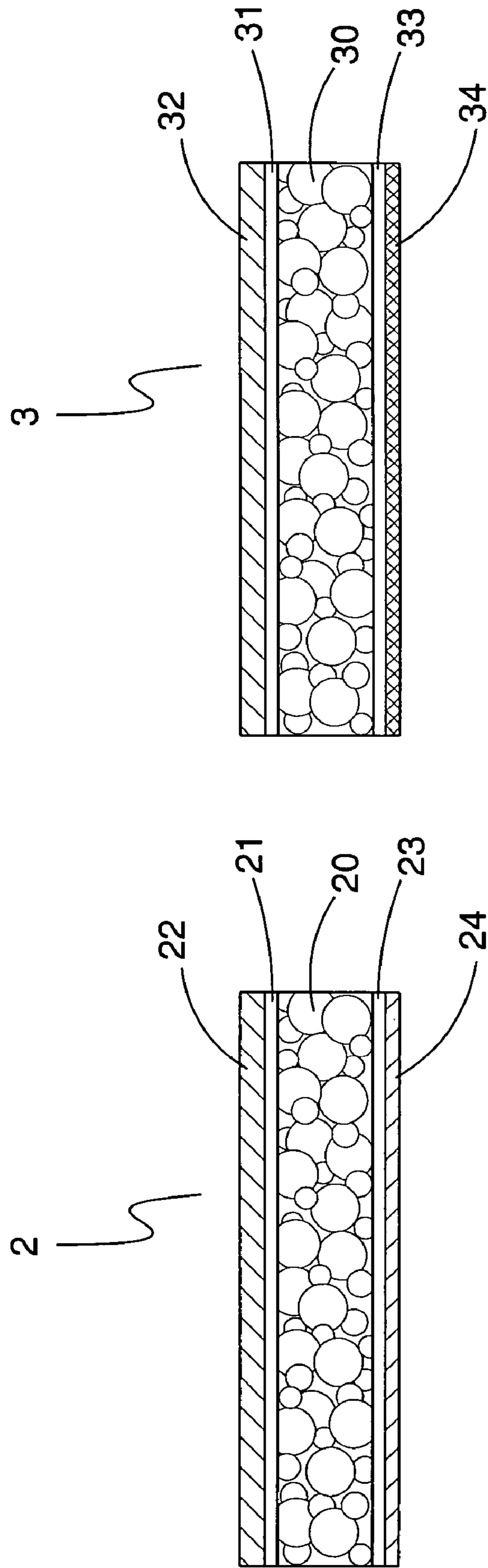


FIG. 5

FIG. 6

1**LAYERED COMPOSITE MATERIAL****CROSS REFERENCE TO RELATED APPLICATION**

This application is a continuation-in-part application of co-pending U.S. application Ser. No. 10/386,634 filed Mar. 13, 2003, which is a continuation-in-part application of the U.S. application Ser. No. 10/040,404 application filed Jan. 9, 2002, now abandoned.

TECHNICAL FIELD

This invention relates generally to a layered composite material, which is not only provided for manufacturing cases, such as suitcases, luggage, tool cases, musical instrument cases, but also for manufacturing pads, mats, toys, bags and sporting goods etc.

BACKGROUND OF THE INVENTION

For the manufacturers of suitcases, luggage and cases, casing materials with lightweight, strong structure and low cost are in substantial demand. Generally speaking, one conventional casing material for suitcases or luggage is a composite metal, which is strong in structure but heavy in weight, also expensive in cost. Another conventional casing material is a composite plastic material, which is lighter in weight and cheaper in cost but poorer in structure compared with the composite metal. For example, an acrylonitrile butadiene styrene (ABS) material is a popular material for manufacturing suitcases, luggage and so on. The ABS material has a nature of wear-resistance but limited. In addition, the suitcases made of the ABS material are easily deformed and the edges of the suitcases are also easily broken, after the impact between the suitcases during transportation.

SUMMARY OF INVENTION

The primary objective of the present invention is to provide a layered composite material with lightweight, strong structure and low cost. The layered composite material not only is provided for manufacturing various cases, such as suitcases, luggage, tool boxes etc., but also for manufacturing pads, mats, toys, bags, sporting goods and so on.

More specifically, in one embodiment of the present invention, the layered composite material comprises a foam skin, a plastic plate and a plastic film. The foam skin has a density in a range of 1.5 to 12 PCF and a thickness in a range of 1 to 6 mm. The plastic plate is laminated to a top surface of the foam skin without adhesives and the plastic plate has a thickness in a range of 0.1 to 2 mm. The plastic film has a surface laminated to a bottom surface of the foam skin without adhesives and the plastic film has a thickness in a range of 0.01 to 0.15 mm. Moreover, the foam skin, the plastic plate and the plastic film are laminated by thermal fusing processes.

In addition, the layered composite material further comprises a fabric layer laminated to other surface of the plastic film without adhesives and the plastic film is as a bonding film between the foam skin and the fabric layer.

Furthermore, the foam skin in the present invention is made of a foamed plastic material, such as polyethylene foam or polypropylene foam. The plastic plate and the plastic film can be a single film or a composite film with

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patterns or colors. Therefore, the layered composite material of the present invention has features of strong structure, lightweight, low cost and also variety.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be more clearly understood after referring to the following detailed description read in conjunction with the drawings wherein:

FIG. 1 is a cross sectional view of the first embodiment of the present invention;

FIG. 2 is a cross sectional view of the first embodiment of the present invention which, showing the plastic film being a composite film with patterns;

FIG. 3 is a cross sectional view of the first embodiment of the present invention, showing the plastic film and the plastic plate being composite films with patterns;

FIG. 4 is a cross sectional view of the first embodiment of the present invention, showing the layered composite material further comprising a fabric layer;

FIG. 5 is a cross sectional view of the second embodiment of the present invention; and

FIG. 6 is a cross sectional view of the third embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

A layered composite material **1** according to a first embodiment of the present invention is shown in FIGS. 1 to 4. In FIG. 1, the layered composite material **1** comprises a foam skin **10**, a plastic plate **11** and a plastic film **12**. The foam skin **10** is preferred made of polyethylene foam skin, which has a preferred density in a range of 1.5 to 12 PCF and a preferred thickness in a range of 1 to 6 mm. The plastic plate **11** is laminated to a top surface **100** of the foam skin **10** without adhesives and the plastic plate **11** is preferred made of polyethylene plate, which has a thickness in a preferred range of 0.1 to 2 mm. Furthermore, the plastic plate **11** in the present invention is preferred made of scratch/wear resistant materials, such as Surlyn® as manufactured by Dupont Corporation and the plastic plate **11** can be a single or a composite plate, according to the varied applications of the present invention.

The plastic film **12** has a surface laminated to a bottom surface **101** of the foam skin **10** without adhesives and the plastic film **12** is preferred made of polyethylene film, which has a thickness in a preferred range of 0.01 to 0.15 mm. In addition, the plastic film **12** can be a single or a composite film. As shown in FIG. 2, the plastic film **12** is a composite film with patterns and comprises a first film **120** and a second film **122**. The first film **120** has a surface formed a pattern **121** thereon and the second film **122** is laminated to the surface of the first film **120** without adhesives, thereby the pattern **121** is covered. Furthermore, the pattern **121** is visible from outside of the plastic film **12**. The composite film with patterns, namely the first film **120** and the second film **122** of the plastic film **12** is applicable to the plastic plate **11** as well.

FIG. 3 shows the plastic film **12** and the plastic plate **11** are composite films with patterns. The plastic plate **11** further comprises a patterned layer **110** and a plastic layer **111**. The patterned layer **110** is laminated to the top surface **100** of the foam skin **10** without adhesives and the patterned layer **110** has patterns therein. The plastic layer **111** is laminated to the patterned layer **110** without adhesives and the patterns are visible from outside of the plastic plate **11**.

Moreover, the patterned layer **110** is a composite layer, which applies the same structure of the plastic film **12** and comprises a first layer (not shown) and a second layer (not shown). The first layer has the same structure as the first film **120** of the plastic film **12** and the second layer has the same structure as the second film **122** of the plastic film **12**, as shown in FIG. 2. Because the structures of the patterned layer **110** applies to the structures of the plastic film **12**, a further detailed description of the patterned layer **110** is omitted.

The foam skin **10**, the plastic plate **11** and the plastic film **12** of the first embodiment are made of polyethylene materials, so they can be easily and directly to be heat laminated to each other without adhesives.

FIG. 4 shows the layered composite material **1** further comprises a fabric layer **13**, which is laminated to other surface of the plastic film **12** without adhesives. Furthermore, the plastic film **12** of the first embodiment is also used as a bonding film between the foam skin **10** and the fabric layer **13** that provides for a thermal fusing bonding to the foam skin **10** and a mechanical bonding to the fabric layer **13**. The bonding film has a preferred thickness in a range of 0.03 to 0.3 mm. Moreover, the fabric layer **13** of the present invention is made of flexible fabric materials, such as woven, jersey, velour and nylon fabrics.

In addition, a preferable laminating method of the foam skin **10**, the plastic plate **11**, the plastic film **12**, namely the bonding film, and the fabric layer **13** is described as followings. First, the material of the plastic film **12**/the bonding film is melted, extruded and directly coated onto the surface of the fabric layer **13**. In the meantime, the foam skin **10** is transported to a bonding device for bonding one surface of the foam skin **10** to the fabric layer **13** through the plastic film **12**. Second, have the melting plastic plate **11** coated and bonded to the other surface of the foam skin **10** without adhesives. In practice, the lamination and the bonding of foam skin **10**, the plastic plate **11** and the plastic film **12** would be various, according to the selected thickness of the plastic plate **11** and the plastic film **12** and/or the single/composite film/layer of the plastic plate **11** and the plastic film **12**.

A second embodiment of the present invention is shown in FIG. 5. A layered composite material **2** of the second embodiment comprises a foam skin **20**, a first bonding film **21**, a plastic plate **22**, a second bonding film **23** and a plastic film **24**. The foam skin **20** is preferred made of polypropylene foam skin, which has a preferred density in a range of 1.5 to 12 PCF and a preferred thickness in a range of 1 to 6 mm. The first bonding film **21** has a surface laminated to a top surface of the foam skin **20** without adhesives and the plastic plate **22** is laminated to other surface of said first bonding film **21** without adhesives. The first bonding film **21** provides for a thermal fusing bonding between the foam skin **20** and the plastic plate **22**. Furthermore, the structure and the material of the plastic plate **11** of the first embodiment are also applicable to the plastic plate **22**, which is preferred made of scratch/wear resistant materials, such as Surlyn® as manufactured by Dupont Corporation and the plastic plate **22** can be a single or a composite plate with patterns.

In addition, the second bonding film **23** has a surface laminated to a bottom surface of the foam skin **20** without adhesives and the plastic film **24** has a surface laminated to other surface of the second bonding film **23** without adhesives. The second bonding film **23** also provides for a thermal fusing bonding between the foam skin **20** and the plastic film **24**. Also, the structure and the material of the plastic film **12** of the first embodiment are applicable to the

plastic film **24** of the second embodiment. Furthermore, it is known that polypropylene materials are incompatible with polyethylene materials whiling bonding. Therefore, the foam skin **20** made of polypropylene is difficult to bond to the polyethylene film/plate **22**, **24** without adhesives. In the second embodiment of the present invention, the first and second bonding films **21**, **23** have the characteristics for bonding the polyethylene plastic plate/film **22**, **24** to the polypropylene foam skin **20** so the plastic plate **22** and the plastic film **24** can be bonded to the foam skin **20** without adhesives, after thermal fusing processes.

FIG. 6 shows a third embodiment of the present invention. A layered composite material **3** of the third embodiment comprises a foam skin **30**, a first bonding film **31**, a plastic plate **32**, a second bonding film **33** and a fabric layer **34**. The foam skin **30** is preferred made of polypropylene foam skin, which has a preferred density in a range of 1.5 to 12 PCF and a preferred thickness in a range of 1 to 6 mm. The first bonding film **31** has a surface laminated to a top surface of the foam skin **30** without adhesives and the plastic plate **32** is laminated to other surface of said first bonding film **31** without adhesives. The first bonding film **31** provides for a thermal fusing bonding between the foam skin **30** and the plastic plate **32**. Furthermore, the second bonding film **33** has a surface laminated to a bottom surface of the foam skin **30** without adhesives and the fabric layer **34** has a surface laminated to other surface of the second bonding film **33** without adhesives. The second bonding film **33** provides for a thermal fusing bonding to the foam skin **30** and a mechanical bonding to the fabric layer **34**.

The structures and the materials of the plastic plate **11** and the fabric layer **13** of the first embodiment are also applicable to the plastic plate **32** and the fabric layer **34** of the third embodiment. The first and second bonding films **31**, **33** of the third embodiment also have the characteristics for respectively bonding the polyethylene plastic plate **32** and the fabric layer **34** to the polypropylene foam skin **30** without adhesives, after thermal fusing processes. In addition, the first bonding films **21**, **31** of the second and third embodiments are preferred to be extruded and coated to the plastic plate **22**, **32** and the second bonding films **23**, **33** of the second and third embodiments are preferred to be extruded and coated to the plastic film **24** and fabric layer **34** as well during laminating processes.

According to the above-mentioned embodiments, the layered composite material of the present invention is comprised by a smooth and flexible foam skin, a tough and wear/impact resistant plastic plate and a patterned and colorful plastic film/fabric layer. In addition, the compositions of the layered composite material are flexible, tough, moldable, lightweight and low cost, so that the layered composite material of the present invention can be applied to various fields.

In the applications to the cases and bags, such as suitcases, luggage, tool boxes, musical instrument cases, sporting bags and so on, the layered composite material of the present invention provides a smooth, flexible, lightweight, cushion-like foam skin as a base or a structure, a tough, wear/impact resistant plastic plate as an outer casing, and a patterned, colorful plastic film/fabric layer as a liner. Compared with the conventional cases, the present invention improves their weights, costs, structures, appearances, also values as well.

Furthermore, according to the advantages of the present invention as described above, the layered composite material can further be applied to other fields. For examples, pads

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such as mouse pads and cup pads, mats such as table mats and sporting mats, sporting goods such as surfing boards, sliders for snow, grass, sand and the like.

Numerous characteristics and advantages of the invention have been set forth in the foregoing description, together with details of the structure and function of the invention, and the novel features thereof are pointed out in appended claims. The disclosure, however, is illustrated only, and changes may be made in detail, especially, in matters of shape, size and arrangement of parts, materials and the combination thereof within the principle of the invention, to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

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I claim:

1. A layered composite material comprising:
a foam skin, having a density in a range of 1.5 to 12 PCF and a thickness in a range of 1 to 6 mm; and
a plastic film, having a surface laminated to a bottom surface of said foam skin and comprising:
a first film, having a surface formed patterns thereon; and
a second film, laminated to said surface of said first film, thereby said patterns are covered, wherein said plastic film having a thickness in a range of 0.01 to 0.15 mm and said patterns are visible from outside of said plastic film.

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